Monitoring Rice Crops from Space

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From Pakistan to Japan, it grows on more than one-third of the cultivated land and provides 35-80 % of the total calories consumed by the majority of Asians. Such numbers illustrate the importance of rice in the South. Yet most rice-producing countries lack adequate data on how much rice is growing where, how well the current crop is doing, and whether or not their supply will meet demand — information that is vital to ensuring food security.

This critical information gap may soon be filled thanks to the IDRC-supported GlobeSAR project (SAR stands for synthetic aperture radar). This broad-reaching initiative helps developing countries benefit from data gathered by Canada's Earth observation satellite, RADARSAT, which was launched in November 1995. Unlike conventional optical satellites, RADARSAT's microwave technology can penetrate heavy clouds, fog, dust, and rain — even during the monsoon season — to record detailed land and water features day or night, year-round.

Training sessions

The Canada Centre for Remote Sensing, which initiated the project in October 1993, trained participants from 10 developing nations in the interpretation of RADARSAT images and related software use. Since the satellite had yet to be launched, they used airborne SAR data that was processed to simulate RADARSAT imagery. Each country then explored the technology's potential across a broad range of disciplines, including crop and soil moisture monitoring, coastal management and mapping, flood and other natural disaster monitoring, and resource management.

Among other uses, China, Malaysia, Thailand, and Viet Nam looked at rice monitoring, successfully proving the feasibility of this application. "We had been looking at the possibility of rice monitoring since 1973, when LandSAT [an earlier generation satellite] first went up, but you couldn't get enough cloud free days to monitor the growing season," says Brian Brisco, coordinator of the GlobeSAR project in China. Using RADARSAT, the goals of rice monitoring are: to determine the total area planted with rice, to estimate the yield, and to determine the environmental impact of rice production.

"Advanced rice production estimates are important from a food security viewpoint by providing an early warning of production shortfalls," notes Dr Suan-Pheng Kam, a GIS (geographic information system) specialist at the International Rice Research Institute in the Philippines. "The added advantage of mapping the actual location of rice areas [is that it provides] a more accurate assessment of the impacts of damage [to rice crops] from natural disasters such as floods or droughts. In the case of rice-exporting countries, it is important for estimating the production surplus for downstream decision making on distribution, storage, and price setting."

Easier to identify

According to Dr Brisco, paddy rice is easier to identify than other crops because when the crop is first planted, the paddies are under water. At this stage, the SAR images appear very dark since water generates no direct backscatter — in other words, it returns no microwave energy to the satellite's antenna. "The images get brighter as the rice grows, then darker again as it matures," he says. "To determine where the rice is, all we have to do is look at the difference between images over time."

The sensitivity of radar to surface terrain also makes it useful for assessing the environmental impact of rice production. In some areas, rice farming causes extensive run-off and erosion. The resulting changes in surface roughness can be readily identified in RADARSAT images.

While the GlobeSAR project has ended, rice monitoring research around the world continues to build on the groundwork it laid. "China and Malaysia are very active in rice monitoring [today], and the International Rice Research Institute is also working with us on a related project," says Dr Brisco.

Research priorities

Post-GlobeSAR research is now focussed on establishing a statistical relationship between rice growth and changes in radar backscatter. "Once we determine that relationship, we can estimate the leaf area index which, along with information on weather, temperature, and rainfall, can be used to estimate crop yield," says Dr Brisco. "By the end of RADARSAT 1, which has a five-year lifespan, we will have developed the rice monitoring application to operational capacity." He expects that rice monitoring will be ready for implementation by the time RADARSAT 2 — the next generation satellite — becomes a reality.

Karen Twitchell is an Ottawa-based writer and editor. [Photo: Brian Brisco]

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